4/18/85

RE: REILLY TAR SITE, ST. LOUIS PARK, Mn. ACL

TO: CHRIS GRUNDLER, OWPE; KITTY TAIMI, OERR;
DAVID HIRD, DOJ; ROBERT LEININGER, SRC

The attached memorandum establishes an action level for
PoH compounds. That level can be construed as an ACL or
Drinking Water Criteria. To satisfy the ACL requirements of
40 CFR 264 Subpart F a detailed explanation of the
hydraulic relationship of the various aquifers and surface water
is necessary. That work is almost complete and will
be submitted, with the attached memo, for OSW, et. al.
review.

Paul Bitter

DATE: JAN 1 1985

SUBJECT: Alternate Concentration Limits for Creosote Wastes, Polynuclear Aromatic Hydrocarbons, (PAH) in Ground Water beneath the Reilly Tar Site, St. Louis Park, Minnesota

FROM: Basil G. Constantelos, Director
Waste Management Division

TO: Gene Lucero, Chief   William Hedeman, Director
Office of Waste Program Enforcement   Office of Emergency and Remedial
                                          Response (OERR)

This memo summarizes discussions and subsequent policy established between Region V staff and your staff at a meeting with you and representatives from OERR on October 18, 1984. The objective of this memorandum is to establish an alternate concentration limit (ACL) for PAH in various aquifers beneath St. Louis Park, Minnesota. The ACL presented here exhibits a water quality that is equal to or exceeds a chronic health risk of $2x10^{-6}$ and is less than a 10^{-5} health risk for drinking water aquifers. The ACL essentially becomes a threshold value that initiates substantial capital, operation and maintenance expenditures and thus requires three major considerations. These are: 1) the degree of confidence in the toxicological models used to develop the health risk; 2) the degree of confidence in measuring very low concentrations of PAH compounds; and 3) the ramifications of selecting various concentrations on the cost and length of time to manage cleanup of an aquifer.

An ACL is not recommended as a controlling mechanism of the surficial aquifer which is not used for drinking water in cities or residences neighboring the Reilly Tar Site. Rather, a hydraulic parameter that will control the pathway of contamination from the surficial aquifer to deeper drinking water aquifers is recommended in lieu of an ACL. This is discussed in greater detail later.

For drinking water aquifers contaminated by PAH we proposed the following ACL. In the absence of benzo(a)pyrene (BaP) and /or dibenzo(ah)anthracene (DBA) measured at a limit of quantitation of 5.6 nanograms per liter (ng/l), the sum of carcinogenic PAH compounds shall be less than 28 ng/l for the water to be considered potable. The water will be considered unsuitable for drinking water purposes if the sum of BaP and DBA is greater than 5.6 ng/l or the sum of carcinogenic PAH, including BaP and DBA, if measured below 5.6 ng/l, is greater than 28 ng/l. The amount of other PAH (PAH not determined as carcinogenic compounds) shall not exceed 280 ng/l. The rationale for this recommendation is attached.

Attachments

BACKGROUND

For discussion purposes, there are 6 aquifers beneath the Reilly Tar site that
are now or potentially affected by contamination from the site. These are shown
in the attached graphic taken from a water treatability study performed by
CH₂M Hill. Three of these aquifers are currently used for drinking water. They
are the Mt. Simon/Hinckley, Prairie du Chien/Jordan and the St. Peter aquifers.
A fourth aquifer, the Ironton/Galesville, may be marginally contaminated at the
source but this aquifer is little used due to the limited yield and the need
for iron removal facilities. Both of these factors make other aquifers cost-
effective for water supply. The fifth and sixth aquifers, the two uppermost
aquifers, are hydraulically connected off-site and can be managed as one aquifer
(Drift/Platteville). These were, at one time, used for residential water supplies
in the area.

The Mt. Simon/Hinckley drinking water aquifer has not been found contaminated,
as yet. Of the two known contaminated drinking water aquifers, one has a well
defined plume of contamination. This is the Prairie du Chien/Jordan aquifer.
The other drinking water aquifer, the St. Peter aquifer, is hydraulically
linked to the Drift/Platteville which is contaminated but no longer used for
drinking water. An ACL is not proposed for the upper aquifers (Drift/Platte-
ville) due to the impracticability of cleaning the aquifers to background
levels or to an ACL. Either substantial capital investment, greater than 100
million dollars, or, operation and maintenance of a pump-out system over
hundreds of years or a combination of both, will be required to restore the
uppermost aquifers to drinking water use. Also, sources of contamination,
other than Reilly Tar, exist in the upper aquifer and would probably contaminate
the area if it were cleaned up. Therefore, pump-out wells are proposed as a
hydraulic control in the upper aquifer to intercept contamination that could
otherwise penetrate the St. Peter aquifer. This measure will protect current
and future use of the St. Peter aquifer as a drinking water supply.
The point to be made here is that an ACL is not the only method that can be
used to protect the use or potential use of a given aquifer; a hydraulic
parameter, independent of a concentration limit, can also be used to protect
the use or future use of an aquifer. The only concentration limit that applies
is the NPDES permit for discharge of the pumped water.

Rationale for the Determination of the ACL for PAH.

Chronic health risks are derived from animal studies whereby dose/response
measurements are recorded over various periods of time and the level of
doses that impart observable tumor responses in animals are extrapolated
to very low levels, to adequately protect humans from low levels of ex-
posure. The mathematical procedure utilized is very simple and exact. The
toxicological methods are also precise and reproducible. The assumptions
used in the translation of animal response data to human response are very
complex and cannot be exact. Therefore very conservative assumptions are
applied.

There are several known PAH carcinogens of which BaP is the most studied
and most potent. The EPA Ambient Water Quality criteria for Polynuclear
Aromatic Hydrocarbons states that "...water concentration of BaP should
be less than 28 ng/l in order to keep the individual life time risk below
10^{-5}. It is recognized that numerous carcinogenic PAH other than BaP are

found in water. However, there is probably little need to derive criteria for all such PAH, since efforts to reduce BaP levels to within acceptable limits will result in the reduction of all PAH."

Controlling all carcinogenic PAH by the levels adopted for BaP conservatively protects the public from potential adverse health affects. In the absence of BaP, weaker carcinogens would control health risk levels such that 28 ng/l of any combination of chrysene and benzo(a)anthracene, weak carcinogens, exhibits a 10^{-6} health risk. If benzo(a)pyrene were detected at a lesser level, no matter how slight, then 28 ng/l of carcinogens would be considered a 10^{-5} health risk. This is due to the toxicological practice of assigning health risks to complex mixtures of carcinogens such that all carcinogenic constituents of the mixture are as potent as the most potent compound found in that mixture. BaP is the most potent compound. It, therefore, becomes critical that analytical technology precisely detect the BaP constituent of PAH compounds.

The EPA water quality criteria document for PAH states that background levels of BaP in water supplies is approximately 1.1 ng/l. No confidence level was given for this measurement. CH2M-HILL, working under contract to the Minnesota Pollution Control Agency (MPCA) through a Cooperative Agreement with EPA, was able to detect spiked samples of BaP to levels as low as 1.2 ng/l. This special effort was validated by the EPA Environmental Monitoring and Surveillance Laboratory before sampling began at the site. Using Hills' technique, no evidence of BaP was found in the drinking water wells. Monsanto Research Center, working for the Reilly Tar Corporation did not find BaP, either, using similar or lower detection limits. As a result, no quality control of field samples of BaP was recorded and no confidence interval was established for measurement of this compound. Based on literature and comparison of various lab data produced from samples taken at the site, it is not unreasonable to assume that data at the low nanogram per liter range have a confidence interval of slightly less than $\pm$ 100% of the reported value.

With respect to other carcinogenic compounds found in water supplies neighboring St. Louis Park and uncontaminated from the Reilly Tar Corporation, there is as much as 2-4 ng/l of carcinogenic PAH in the treated water. Some other cities monitored in the U.S. also have about this range of carcinogenic PAH in treated water. Non-carcinogenic PAH in all instances were much higher. There are instances in St. Louis Park and neighboring cities whereby inferences can be made that the distribution systems contribute trace levels of PAH to the drinking water. This is possibly a result of coal tar lining used at the joints of the distribution system. With a confidence interval of $\pm$ 100% we can assume that background levels of carcinogenic PAH vary between 1 and 8 ng/l in drinking water supplies, of which BaP can constitute from less than 1 to 2.4 ng/l (using a method detection limit of 1.2 ng/l for BaP).

Typical levels of carcinogenic PAH found in the contaminated drinking water wells in St. Louis Park, MN. are somewhat above 28 ng/l. The carcinogens are benzo(a)anthracene and chrysene which, at 28 ng/l, exhibit a 10^{-6} health risk, in the absence of BaP. Without the presence of BaP we are conservatively protecting the public health at 28 ng/l for the carcinogenic compounds thus far detected in the drinking water wells. Since BaP is a constituent of creosote and creosote is the source of contamination of the aquifer, we should be cautious in the event that BaP is detected in the future. To be somewhat more protective we should also regulate dibenzoanthracene (DBA) in the same manner as BaP since the

potency of DBA is somewhat less than that of BaP. Therefore, we propose a threshold value whereupon if BaP and/or DBA are detected at that value, remedial action is required. Since this triggers substantial capital and operation and maintenance investment on part of the government or owner/generators, we must be certain of its measurement. This value is the limit of quantitation and is generally 2 to 3 times the method detection limit.

For BaP found alone at 2.8 ng/l, the toxicological models indicate a 10^{-6} health risk. A value of 28 ng/l for BaP represents a 10^{-5} health risk. If it is our goal to assure a level of protection of approximately a 10^{-6} health risk, we should strive to measure 2.8 ng/l of BaP. With a documented method detection limit capability of less than 2.8 ng/l and with a $\pm$ 100% confidence interval, we can say that BaP can be measured, with certainty at a level of 5.6 ng/l. This also allows us to say with certainty that a 10^{-6} health risk level with respect to BaP and/or DBA has been exceeded although the risk is still substantially less than a 10^{-5} level according to the models.

Proposing 5.6 ng/l of BaP/DBA as a threshold value serves the following comparison. Found alone in water it represents a $10^{-5.7}$ health risk. This is equivalent to a health risk of 2×10^{-6}; that is, 2 people out of a million may contract cancer, drinking 2 liters per day, with that level of BaP in the water, over a 70 year period. The average daily dietary (food) intake of BaP alone, is estimated at 160 ng/day to 1,600 ng/day. At 5.6 ng/l, 2 liters/day, 11.2 ng of BaP is ingested per day. This represents 0.7% to 7% of the average daily food intake.

The difference between 28 ng/l for the sum of carcinogenic PAH including BaP, and 5.6 ng/l as an upper level of acceptable BaP concentrations represents the degree of toxicological uncertainty of the interaction of BaP with other weaker carcinogens. Thus, when we attempt to control all carcinogens in the PAH family by assuming they are all as potent as BaP, we are very conservatively protecting the public health. Therefore, because of our previous argument, based on existing literature, we propose to regulate only DBA as the same potency as BaP.

Once having exceeded either 5.6 ng/l for the sum of BaP and DBA, or 28 ng/l for the sum of all carcinogenic PAH, technology will afford a treatment that will reduce BaP and DBA beneath detection limits, affording a chronic health risk of equal to or less than 10^{-6}.

According to the Record of Decision for restoration of drinking water quality to St. Louis Park, Minnesota, June 6, 1984, the values used to maintain the treatment efficiency of granular activated carbon are 280 ng/l for other PAH (PAH not determined as carcinogenic compounds) which would correspond to a carcinogenic PAH value of 2.8 ng/l which, according to previous reasoning, is equal to a 10^{-6} health risk if BaP and/or DBA were found or 10^{-7} health risk if they were absent. This is due to the relationship established between total PAH compounds and carcinogenic compounds found at the site, and in breakthrough studies conducted at the site which shows a ratio of about 100 to 1 in the worst case. This value is conservative, i.e., the ratio of total PAH to carcinogenic PAH is typically greater than 300 to 1. Since 2.8 ng/l of carcinognic PAH represents the sum of 9 compounds, each compound cannot be individually measured. Thus 280 ng/l of total PAH is selected for monitoring performance of the GAC

columns, when carcinogenic compounds are not measurable. Thus, 280 ng/l is also used as an ACL for the non-carcinogenic PAH criterion. The total criteria, then, that constitute an ACL for PAH compounds are:

5.6 ng/l for the sum of BaP and DBA;
28 ng/l for the sum of total carcinogenic PAH; and
280 ng/l for the sum of other PAH.